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THESIS

**Renovation of
Old Apple Orchards**

James Franklin Illingworth

1912

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RENOVATION OF OLD APPLE ORCHARDS.

Thesis submitted to the Department of Pomology
of
Cornell University
as a minor for the degree of
Doctor of Philosophy

by

James Franklin Illingworth. 1870-

Ithaca, N. Y.

May 29th, 1912.

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RENOVATION OF OLD APPLE ORCHARDS.

INTRODUCTION.

The last available census - 1900 - places New York at the head of the list of states in the production of apples, and even when all orchard fruits were taken into consideration, California alone surpassed the Empire State.

The 15,000,000 apple trees in New York produced in 1899, - which was considered an average year, - 24,111,257 bushels. Though we found no definite figures, giving an idea of what this crop returned in cash, we must conclude that the price per bushel was very low, since the total return for all orchard fruits for the State was \$10,542,272.

We can easily understand the reason for this low valuation of apples, if we visit the markets in various parts of the State. It is a common sight to see fruit exhibited for sale, which is so blemished by fungi and insects, that its removal from the orchard should be prohibited by law. In several of the best fruit sections of the West, the grower of perfect fruit finds such protection from infestation of neglected orchards.

Will apples not pay if well grown? This question naturally arises when we see the market filled with in-

ferior fruit. The answer is apparent when we find in the same markets, western apples selling from the box at five cents apiece, - just about double the price of oranges. Sections that will produce citrus fruits are very limited in this country and sharply defined by frost limits; while apple producing sections are country wide.

Western growers have demonstrated that there is money in apples, and even after they have paid out more for transportation than is received for much of the Eastern fruit, there is still enough margin left to pay a good interest on a valuation of one thousand dollars or over per acre. An orchard survey of one of the average fruit producing sections of Oregon, was published in Bulletin 101 by the Experiment Station. Computing all the orchards of Jackson County - good and poor - the average gross return was \$244.30 per acre, expense for cultivation, spraying, marketing etc., \$60.72, leaving an average net return of \$183.58 per acre for the whole county. Many of the better orchards of the county produced from \$500 to \$600 per acre, and one 20 acre orchard of Newtown's produced \$1341.60 per acre, - these went to England. Equally large returns have been produced in some of the best eastern orchards - particularly those that receive scientific treatment, in the Ontario Lake region.

A casual survey of the older apple orchards in many parts of New York State, shows a very large list of varie-

ties, many of which are of low commercial value. If we are growing apples on a commercial basis, it becomes necessary to have a few select varieties, and it is best to have these in blocks in so far as pollination will permit. No attempt will be made to indicate here what varieties are best to select, for this matter has been worked out carefully for the several sections of the State by Hedrick and others (1906) in Geneva Bulletin 275. Renovation by top-working old trees is a slow process and hardly practical where most of the trees are of poor varieties. Of course, here and there an inferior tree may be worked over with profit, because of the difficulty of starting a new one in its place.

Many of the old neglected trees appear to have lost the bearing habit, as a result of a starved condition. In many cases the soil has been packed down hard about the roots for years, and the tops are a thicket of branches, excluding air and light. Even in cases where blossoms develop, the fruit may fail to set on these trees.

There are several causes which may "nip the fruit in the bud", but chief among these are insects and frost. The bud moth is common in every neglected orchard. The tiny larvae winter over on the bark, the caterpillars eating their way into the buds, just when they are opening. The flowers may expand in profusion, giving promise of a full crop, but the larvae eating at the heart of the bud

clusters, cause the fruit to drop soon after the petals fall. There are a number of other insect pests that attack the opening flower-buds, causing a failure of the crop. During the past season, the orchards about Batavia, N. Y., were attacked by a leaf-roller. The newly hatched caterpillars tied the opening leaves of the flower clusters and ate off the flower stems, so that there was practically a failure of the crop in some orchards.

Frost is worse in low lying regions where there is no body of water near to temper the climate. A good indication as to whether frost is a limiting factor may be determined by the setting of the fruit.

Even worthless fruit is encouraging if produced in abundance from year to year on the neglected orchard. It indicates that there is little trouble from frost, which if it is the chief limiting factor, can only be met by expensive orchard heating.

If the orchard is so situated that there is a freedom from late frosts, the problem is greatly simplified. The trees may be rejuvenated and the quality and quantity of the fruit much increased by careful orchard management.

FACTORS TO BE CONSIDERED IN ORCHARD RENOVATION.

Orchard renovation naturally presupposes that the orchard is run down and hence, is no longer profitable. In some cases, of course, neglect has gone so far, that



Fig. 1. Apple trees ruined by crowding.



Fig. 2. A bad crotch - Large lower limbs have also been removed.

it would appear useless to spend money or time in an attempt to bring the orchard up again. Where the trees are of poor varieties and less than 60 per cent stand, it would certainly be better to remove them altogether and start a young orchard.

We would only discuss, then, the profitable renovation of orchards which are fairly sound at the heart, of standard varieties and located in sections where orchard heating is not required. The important factors of this treatment are given in the headings which follow.

REMOVING SURPLUS TREES.

It was common in the older orchards to crowd the trees, and where they were not thinned out in time, most of the pruning was done by removing the lower branches. (Fig. 1 and 2) This practice has developed a type of tall, slender trees, which are difficult to ever reduce to the ideal form again. In any case, however, if we are going to bring the orchard back to profitable bearing, the surplus trees must be removed, so that the ends of the branches of those remaining do not touch. In this thinning process, it is best to first make a chart of the orchard upon which can be carefully indicated the condition of each tree. In this way, by removing the diagonal rows that contain the most poor trees and skips, the maximum number of good trees is left. Though it is with

reluctance that one removes sound trees when they come in the rows that are taken out, and especially where they stand next to blanks in the remaining rows, the final results will be more satisfactory if the above plan is strictly adhered to. Trees in regular rows are more pleasing to the eye and facilitate orchard management.

SOIL TREATMENT.

Many orchards of the State are suffering from a surplus of soil moisture. Sometimes only a corner of the orchard is so affected, and most of the trees are dead there. In any case, if the soil remains saturated into the summer, it is unfit for the growth of apples. This fruit quickly succumbs to the so-called "wet feet". Drainage is of first importance in such orchards. A row of tile, laid about three feet deep, in every other space will soon produce a marked change in the health of the trees.

Wet soils are usually sour and require a heavy application of lime before they are attractive to most plants. While lime can not be considered as a fertilizer, it often gives a stimulus to plant growth that is remarkable. It not only sweetens and improves the physical condition of heavy soils, but also dissolves the mineral fertilizers which have been lying dormant in the earth, rendering them usable by the plants. Hence, application

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of lime alone, though it gives remarkable stimulus to plant growth, will soon deplete the soil of its natural fertility and should be combined with real fertilizers.

Basic slag appears to be one of the cheapest and best fertilizers for eastern orchards. It is being used with success by many orchardists, - (Drew, 1911, and Fraser, 1912). This slag is a by-product from the manufacture of steel and contains in each ton, about 900 lime and 360 pounds of phosphoric acid. An annual application of 500 to 1000/^{pounds} has given excellent results in growth, color and finish of fruit. If the orchard is heavily pruned it may be best to delay the application of other fertilizers until the second year. Barnyard manure is valuable for the humus and nitrogen that it contains. The potash must be supplied from some other source, - the sulphate or muriate of potash being the form commonly used, with an application of about 200 pounds per acre annually.

All fertilizers should be applied out under the ends of hanging branches, since here is the place that we find the feeding roots. It is a poor investment to scatter the fertilizers about the trunks of old trees, for the roots in this part of the soil are covered with a heavy bark and do no absorbing.

Other soil treatment will be taken up under the head of cultivation.



Fig. 3. Crowding forces the branches upward.



Fig. 4. The same trees with the tops brought down.



Fig. 5. Trees worth saving.



**Fig. 6. Sterilizing and waterproofing the wounds,
after removing the surplus wood.**



Fig. 7. A good type for renovation.



Fig. 8. After pruning.



Fig. 9. The next summer.

PRUNING.

The two principal points to be kept in mind in the pruning of a neglected orchard are:

(1) To keep the trees low so that they may be handled economically.

(2) To open up the head so that air and light can get into the center of the tree, to give greater bearing surface.

Crowding has developed the trees upward and some of the branches are so tall that they can never be properly sprayed, and the fruit can only be secured by shaking it off. Such large trees should have the upright branches removed, making a slanting out very near a side branch. (Figs. 3 and 4.) In very old trees the tops may be lowered ten or fifteen feet in this way with advantage. In opening up the head, care must be taken not to overdo the work. There is danger from sun-scald, where large lateral limbs are left entirely exposed. In removing lateral branches, prune out only those that interfere or are badly diseased. Never cut a large, healthy limb from the lower part of the tree, unless there is an over crowding. Where the trees have been headed very high, lower branches may be developed by saving some of the water sprouts which form on the trunk. These will be forced into rapid growth by the removal of the top of the tree. In a few years a new head may be built out in this way,

to replace the branches that are wanting.

Removing so much wood from the tree has a tendency to stimulate the growth of the remaining wood, and hence, hastens the healing process. Where trees are too vigorous, however, a rank growth of watersprouts may be thrown out. These must be trimmed back during the summer; saving only those that are needed to improve the shape of the tree.

It has been generally accepted among horticulturists that summer pruning stimulates fruit production, and that winter pruning forces a growth of wood. Heavy topping of Ohio orchards during the dormant season, caused such a development of fruit, that the results would seem to conflict with the above views. In the orchards treated, the lateral branches were so overloaded with fruit following pruning, that in some cases they were broken down. The increased development of wood was also remarkable. It would appear that the removal of the strong, upright branches, which normally bore the crop on the highest tips, threw the sap into the fruit buds of the laterals, causing them all to set fruit.

Mr. Cole (1912) has noted similar results in Virginia, where he has hastened the fruiting of young trees by removing the upright branches from the center of the tree, during the dormant season.



Fig. 10. Badly neglected, but well headed.



Fig. 11. Tree ruined by crowding and high pruning.



Fig. 12. The same with top cut back.



Fig. 13. Improper cuts and lack of protection.
Line at left indicates proper angle
for cut.



Fig. 14. Result in the final downfall of the tree.



Fig. 15. Beginning of the end.



Fig. 16. The cavity extends from the snag to the hole at the root.

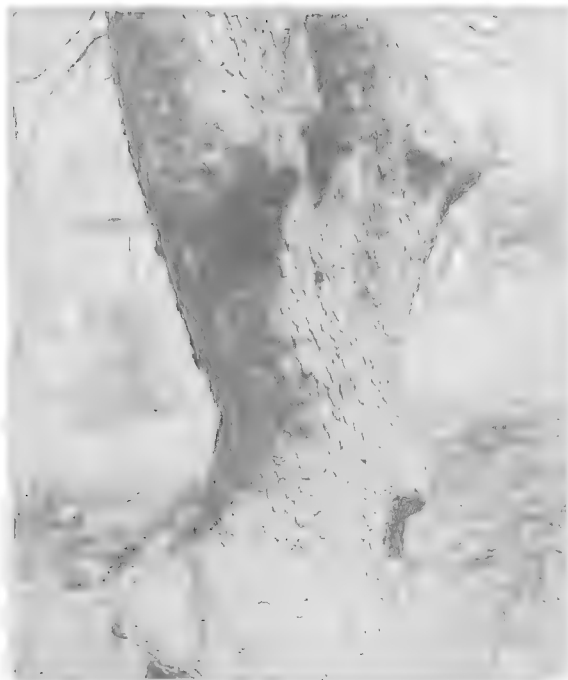


Fig. 17. The apple tree makes a noble effort to cover up long snags.

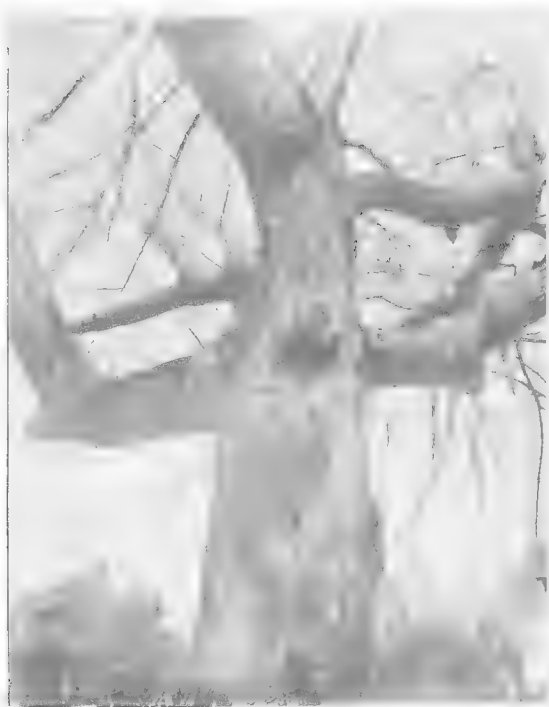


Fig. 18. But often fails.

TREE SURGERY.

In reality the removal of large branches might properly come under this heading. The principal decay that we find in old orchards has originated through the leaving of long stubs. The pruning is usually turned over to the cheapest help on the place. Even the owners themselves, when ignorant of the vital principles of the tree, cut off the branches at the place most convenient; often leaving stubs six or eight inches long. One experienced farmer explained his method of pruning by saying that the wood was going to die back anyway, and by cutting a long stub, it took that much longer for the decay to get back to the trunk. Sample illustrations of his methods and results are shown in figures 13 to 16.

All cuts should be made rather close to the main branch, and in topping back a limb, as shown in figure 13, the slanting cut, indicated by the line, heals much quicker and surer than the one shown. All the cuts, and in fact, all scars in the bark are a constant menace to the life of the tree if left exposed to the attacks of insects and fungi. The insect burrows are well shown in the exposed side cuts of figures 13 and 14.

A brief knowledge of the movements of the sap in the tree will show clearly the folly in leaving long stubs. The soil water passes upward through the sapwood to the leaves, where it is used in the manufacture

of building sap. This sweet material, passing downward in the inner bark, stimulates and builds up only those parts that lie in the direct path between the leaves and the roots. Hence, it will be seen that the sap in descending from the branch at the left of figure 13, will flow along the slanting line, the wood above this line receiving no nourishment, soon dies and decay begins.

All fresh wounds should be sterilized with bichloride of mercury (1-1000), made by placing one tablet in each pint of water. After this is dry, all cuts should be covered with some good waterproofing. Pure lead paint, without turpentine, is usually recommended, but we have had excellent results from the use of the following mixture:

Rosin	1 part
Pine tar	1 part
Boiled linseed oil	1 part.

These should be heated together, using care to keep away from the flame, for the mixture burns readily. Also, it is dangerous to drop water into the hot mixture, for it causes a violent spattering and foaming, that soon runs over the sides of the kettle and catches fire. When the mixture, tested in water, has the consistency of taffy, it is ready to apply to the cuts while warm. This coating leaves no opening for the entrance of water or insects, which carry spores of the fungi and cause decay.



Fig. 19. Cavities prepared for the filling.



Fig. 22. A bad crotch that required special bracing.



Fig. 23. Was a bad wreck but is now making good.

Fig. 24. A nearer view of the same showing how it is rapidly covering the fill.



Fig. 20. A bad decay cleaned out.



Fig. 21. Putting in the bracing.



Fig. 25. Old timers, which are renewing their youth.

The treatment of cavities, to be successful, requires considerable training. This process will be best understood by a comparison with the filling of teeth by a dentist. The three important processes in each case are:

(1) To remove all decay and sterilize to prevent further decay.

(2) To prepare the cavity (Fig. 19) so that it will hold the filling.

(3) To exclude all foreign substances.

If this work is carefully done the results are much better, even than those of dentistry, for a new tree grows up in a few years, surrounding the filling (Figs. 24 and 25). Since new living layers are annually added to the outside of the wood, the life of the tree, it would appear, is only limited by disease or starvation.

Old orchards have many trees with weak upright crotches, due to poor training in youth. These should be braced (Figs. 21 and 22) before the trees are loaded with fruit. This may be easily done by tying a cable, or chaining to lag-hooks screwed into opposite branches. Where three branches can be tied together, forming a triangle between the hooks, the greatest strength is secured.

A further bracing in the crotch itself (Fig. 21) may be done by boring one or more holes through the trunk and securely bolting the parts together. The heads of



Fig. 26. A poor way to support a weak crotch.

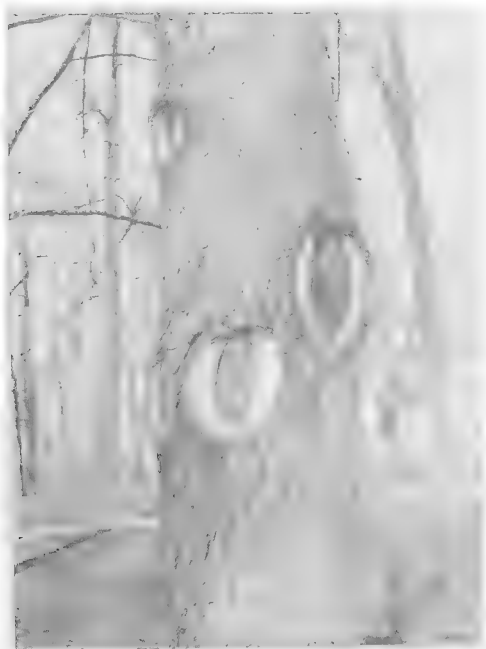


Fig. 27. Healing well started.



Fig. 28. A perfect result.

the bolts should be set into the bark (Figs. 24 and 25) and the wounds treated as for other cuts, so that they soon heal over. In no case should these bolts be used without cables above to retard the strain of the branches, for many trees have broken off at the point where the bolt passed through them. Neither should bands be used to hold a weak crotch for the increase in size soon cuts these into the bark and the roots are starved, since the descending sap is retarded, or cut off altogether (Fig. 26).

SCRAPING.

The bark of old neglected orchards is often very rough and covered with lichens and moss. This rough covering acts as a hiding place for innumerable insect pests and egg masses, and should be removed, using care not to scrape into living layers. Any exposed or broken places in the bark will lay the tree open to an attack of any one of the numerous fungous diseases and rots which destroy the life of the apple.

We would only advocate scraping when the trunk becomes very scabby, or in some varieties only in the first treatment of renovation. Trees in a good healthy condition may do just as well without it, and in fact many growers are strongly against the practice.

SPRAYING.

There was a time, apparently, when fruit could be grown without the many troubles that we now experience. At present, however, there are few if any parts of the country where perfect apples can be grown without spraying.

It is a common practice in commercial orchards to make about four applications. These may differ as to the fungicide used but the most up to date orchardists, follow a program as here indicated.

First Treatment. After the work of pruning and scraping has been finished, and the buds are beginning to swell, the trees should be given a thorough cleaning up, spray with lime-sulphur. The commercial lime-sulphur tests about 32 or 33 degrees Baume and should be diluted with eight parts of water before applying. If the weather has been comparatively warm for a few days and the buds are rapidly swelling, arsenate of lead should be added to this spray at the rate of about two pounds to each fifty gallons. This will aid materially in the control of the bud-moth, the caterpillars of which begin to emerge from their winter cases preparatory to entering the newly opening buds. Hence, if the buds are well coated with poison, the first meal eaten from the surface destroys the pests before they can get inside. After the caterpillars have once gained an entrance, further spraying appears to have no effect on

them, for they feed entirely upon the newly developing tissues.

The arsenate of lead acts as a poison for all leaf and bud eating insects, and also increases the fungicidal value of the spray, as shown recently in Cornell Bulletin 290. Hence, the evident value of using this poison in every spray that we apply.

Second Treatment. Since the neglected orchard is usually so infested with pests, both fungi and insects, it is best to apply this spray just when the flower buds appear red, before they open. In clean commercial orchards, this application may not be necessary, in sections where there is no trouble with scab. This, and all succeeding sprays, while the leaves are on the trees, must be more dilute or the foliage will be burned. It is best to use about 40 parts of water to each part of the commercial lime-sulphur. The arsenate of lead is always added to hold in check the hords of caterpillars and other chewing insects.

Third Treatment. This may be called the first codling moth spray. It should be applied at the same strength as the preceding and within ten days after the petals fall. The application should be with considerable force, the idea being to get the poison into the flower end of each developing fruit before the calyx lobes close. The importance of this treatment can not be over estimated

for if this spray does not poison the inner calyx cup, it is impossible to get clean fruit. The young usually enter between the closed calyx lobes, and if they find no poison in the cavity, their further entrance into the fruit is assured.

Fourth Treatment. This is usually called the second codling moth spray and should be applied about three weeks after the petals fall. It is at about this time that the majority of the codling moth caterpillars are hatching. This spray is to coat the fruit with a fresh layer of poison, and supplement the preceding spray. If all of these treatments have been thoroughly applied, the best orchards may be fairly free from pests during the rest of the season. Badly run-down orchards will require at least one more application to save the fruit from second brood codling moth and fruit rots.

Fifth Treatment. Since Bitter rot and some of the other late developing fruit-destroying fungi are not easily controlled with lime-sulphur, we would use for this treatment, bordeaux of the usual 4-4-50 strength, and add the two pounds of arsenate of lead. The application should be about the last of July, to head off the newly hatched, second brood larvae of the codling moth. These are what are known as the "side worms" in the orchard, from their habit of entering through the side of the apple. Since they must eat their way through the skin of the fruit,

poison properly applied will destroy them at their first meal.

CULTIVATION.

If the trees are to make renewed growth, rapid healing of the wounds, etc., it is necessary that the soil be broken up. This may be accomplished in any way that will give the best results. In ordinary cases where the soil is of a fairly loose texture, a shallow plowing will accomplish best results. If care is used the root system need not be severely injured by this process, for it is only necessary to break up the sod covering.

Where the trees are badly root bound in a heavy soil, or where the "hard pan" comes close to the surface, the use of dynamite proves effective. In many of the Western orchards, even the young trees are planted only in holes which have been "shot". By this treatment the soil is loosened up and the roots find an ideal condition for absorption, it being not only easier to grow out into new food supplies, but the loosened soil is also more retentive of moisture.

The shooting of an old orchard requires about four sticks of powder per tree. Eight holes should be made around the tree in a circle, under the tips of the branches. This may be done by forcing a bar down two or three feet into the soil before it dries out in the spring. A half

stick of powder is commonly used in each hole, with fuse to reach the surface of the soil. All the holes are prepared and moist soil well tamped in on the powder before any of the fuses are lighted. The effect of the combined explosion shows little on the surface, but the soil is thoroughly loosened between the holes, as one can easily demonstrate by digging down.

Extensive experiment at Geneva station (Bulletin 314) has demonstrated the value of keeping a surface mulch of loose soil in the orchard throughout the dry season. It is a recognized fact, that under the arid conditions of the West the production of fruit would be impossible without this thorough cultivation. The spring-tooth or cut-away harrow may be used for the purpose. The ground should be gone over every ten days or two weeks, and at least after each rain so that a surface crust is never allowed to form. In this way the maximum amount of moisture is conserved and sent out through the leaves, where it does its work toward plant building.

THINNING.

This, also, is now of recognized value in the commercial orchard. (Geneva Bulletin 239) Frequently the heavy pruning of the renovated orchard forces an over load of fruit, and this must be thinned if we would conserve the trees and have first class apples. The cost of thin-

ning, if done soon after the "June drop", is about fifty cents for each large tree.

Unthinned apples are not only smaller, and of poorer shape and color, but they also have many more worms. The second brood codling moth larvae usually enter between the crowded apples, - so by thinning we secure better spraying results, and relieve the tree of developing the inferior fruit.

COVER CROPS.

No cultivation should be done in the orchard after July, as it has a tendency to stimulate the growth too late into the fall. This not only hinders the hardening of the tender wood, to withstand the winter, but also results in a poor coloring of the fruit.

Cover crops should be planted about the middle of July and left on the ground until the following spring. They have been divided into two kinds: (1) nitrogenous, and (2) non-nitrogenous. To the first group belong all plants of the pea family, such as clover, vetches etc.; to the second, other plants which produce no nitrogen nodules on their roots, such as buck-wheat, rye, etc. Both of these groups are valuable in protecting the soil during the winter and in supplying humus when plowed under in the spring.

Rye and buckwheat will make a good growth on even the

poor soil of the run-down orchard, and are better to plant for the first crop, since the clovers never do well on soils poor in lime. After this mineral has been supplied, either in the form of basic slag or pure lime stone, and worked into the soil during the first season, a legumenous crop may be tried. If clovers will grow they are the cheapest source of nitrogen. The vetches make an abundant growth on limed soils, but the price of seed practically prohibits their use on lands of low value.

Gover crops which make a good growth in the fall may be rolled down just before the fruit is to be picked, and thus form a carpet covering the ground.

RESULTS OF RENOVATION.

Rhode Island State Board of Agriculture estimates the value of old Baldwin and Greening apple trees based upon their earning capacity. They decided that a tree forty years old was worth \$150.00 and at sixty years of age, \$250.00.

This looks like a high valuation at first sight, but when we look at the results of Mr. Drew (1911) in Connecticut, we gain some notion of the real value of our old neglected apple trees. He produced from twenty-five year old Baldwins, nine barrels of choice fruit per tree, three years after renovation. Such profits would pay a high rate of interest on a valuation of a thousand dollars or

more per acre.

Good old apple trees, that might be saved for many years, are scattered throughout the country, and are permitted to gradually succumb to the attack of their many enemies. Even in the neglected condition that we find the average farm orchard of this State, the owner usually admits that it is the best paying part of his place.



Don't results like this pay ?

BIBLIOGRAPHY.

We include here references to all papers that have been found useful to us in working up the subject of apple orchard renovation. Published accounts on the subject are mostly of recent date, and many of the shorter articles appear in various farm papers. There has been no attempt to include those which are not readily available. We include after each reference annotations which we have found of value.

- 1894 Bailey, L. H. The cultivation of orchards.
 293-314 p. illus. (New York Cornell Agr. Exp.
 Sta. Bul. 72.)

This bulletin takes up the renewing of orchards by thorough cultivation, cover crops and fertilizers. Shows ideal harness for orchard work.

- 1895 Bailey, L. H. Recent apple failures in Western
 New York. 34 p. col. pl. illus. (New York
 (Cornell) Agr. Exp. Sta. Bul. 84)

Describes methods of bringing up old orchards, some of them planted in 1860. Reports of various growers in the Ontario Lake region as to the beneficial effects of spraying, etc. Describes renovation of old orchard in Michigan, that at first seemed hopeless task. Trees made to produce a heavy crop even though the year was very dry.

- 1896 Waugh, F. A. Apple growing in Grand Isle County.
 81-95 p. illus. Vermont Agr. Exp. Sta. Bul. 55.

General consideration of varieties and other factors for successful apple production in this

region. Of value to one securing orchards for renovation.

- 1897 Corbett, L. C. Apples. 199-215 p. 5 pl. (In Dept. Agr. and Hort. In West Virginia Agr. Exp. Sta. 9th Ann. Rept. for 1896.)

Method of pruning differs with varieties. King and Willow varieties - heading in; Ben Davis and Baldwin varieties - thinning the branches.

Top-worked trees last much longer than root-grafted.

1897. Card, F. W. Notes on pruning. 10 p. illus. (Nebraska Agr. Exp. Sta. Bul. 50)

Experiments with various coatings to determine the effect upon healing and permanency. Lead paint and coal-tar were found to last best. Coal-tar had a tendency to hinder healing. Shellac and pine-tar did not last.

- 1899 Aldrich, H. A. An experiment in pruning old trees. 48-54 p. (In Illinois St. Hort. Soc. Trans. for 1899.)

Old trees which had been subject to non-bearing for years, were given over to thorough pruning, the whole top being headed in from 1 - 3 feet. A yield of 20-30 bushels of apples per tree was obtained the first season, besides a good growth of wood.

- 1899 Alwood, W. B. Spraying the orchard. 83-104 p. illus. (Virginia Agr. Exp. Sta. Bul. 100.)

General notes on spraying, showing a neglected orchard, and two years after treatment.

- 1900 Blair, J. C. Orchard management. 371-396 p. illus. (Illinois Agr. Exp. Sta. Bul. 59.)

Treats of some of the reasons that apple orchards fail in Illinois. General notes on renovation.

- 1901 Waugh, F. A. and Cummings, M. B. Apple growing
 in Addison County. 29-36 p. illus. (Vermont
 Agr. Exp. Sta. Bul. 90.)

General factors of renovation of Apple
Orchards of the County discussed.

- 1902 Card, F. W. Improving an Orchard. 141-152 p.
 illus. (Rhode Island Agr. Exp. Sta. Bul. 83.)

Gives the methods of renovation of an old
orchard of about one acre.

- 1902 Powell, G. H. Top working orchard trees. 243-
 258 p. iv pl. illus. (In U. S. Dept. Agr. Year-
 book for 1902.)

Details of different methods of grafting,
etc., that may be of use in the renovation of
apple trees.

- 1902 Walker, E. Why apple trees fail. 32 p. illus.
 (Arkansas Agr. Exp. Sta. Bul. 71.)

Consideration of the reasons that old
apple orchards fail. 1. Poor soil, 2. close
planting, 3. lack of culture, 4. poor care of
trees, 5. poor nursery stock, 6. Sun-scald,
7. disease, 8. insects, 9. bad pruning, 10. over-
bearing, 11. Root rot, etc.

- 1903 Munson, W. M. Experiments in Orchard Culture.
 24 p. illus. (Maine Agr. Exp. Sta. Bul. 89.)

Relative merits of different treatments of
orchards, including cultivation and mulching;
orchard renovation and top grafting, etc.

- 1903 Beach, S. A. Thinning apples. 195-224 p. illus.
 New York (Geneva) Agr. Exp. Sta. Bul. 239.

Of use in the renovation of orchards. Ex-
periments to demonstrate the increase in value
of fruit by thinning.

- 1904 Powell, G. H. Relation of cold storage to commercial apple culture. 225-238 p. 7 pl., 4 col. (In U. S. Dept. Agr. Yearbook, 1903.)

Approximately 15 million apple trees in N. Y. as given in the census for 1900. Takes up the causes and control of glutted fruit market.

- 1904 Rane, F. W. Experiments in orchard management, etc. 85-106 p. illus. (New Hampshire Agr. Exp. Sta. Bul. 110)

General factors of orchard practice, renovation notes, etc.

- 1905 Bues, C. Renovating an apple orchard in Western New York Chap. VI, 295-298 p. (In New York [Cornell] Agr. Exp. Sta. Bul. 226.

Describes the renovation of a nine acre orchard of 32 year old trees. Trees suffering from "wet Feet". Canker had destroyed many of the limbs. In as bad a state as it could well be.

Treatment. Water drained, dead wood removed, land plowed, sprayed with Bordeaux and arsenic. Plant food supplied to supply new wood.

The Kings, Greenings and Russets grew new tops, the Baldwins doing so at a slower rate. Old cankers overgrown.

From a business standpoint. The 54 acre farm cost \$2200 in 1896. Gross returns following renovation: 1896-\$250. 1897-\$12. 1898-\$800. 1899-\$800. 1900-\$1200. 1901-\$300. 1902-\$2000. 1903-\$1400. 1904-\$2722.50.

- 1905 Macoun, W. T. Apples. 108-127 p. illus. (In Rept. Hort. In Canada Exp. Farms Repts. for 1904.

Top working old trees with hardy varieties. Cover crops. Horse beans lived through winter.

Hairy Vetch hard to turn under. English horse bean and rape an ideal cover crop; hold the snow well and easily broken up by disc harrow. The beans furnish nitrogen and humus, rape covers the soil

- 1905 Munson, W. W. Experiments in orchard culture.

Sec., 1905. 181-204 p. illus. 22 1/2 cm.

(Maine Agr. Exp. Sta. Bul. 122.)

Pruning, cultivation, fertilizing in orchard renovation (2d rept.) (See Bul. 89 for first rept.)

- 1905 Paddock, W. Pruning fruit trees. 15 p. illus.

(Colorado Agr. Exp. Sta. Bul. 106.)

This bulletin treats of young trees primarily but shows old trees well headed.

- 1906 Hedrick, U. P., Booth, N. O., and Taylor, O. M.

Apple districts of New York with varieties for each. 61 p. (New York 'Geneva' Agr. Exp.

Sta. Bul. 275.)

Very useful information, when selecting an old orchard in the State for renovation.

- 1906 Munson, W. W. Orchard Notes. 61-80 p. illus.

(Maine Agr. Exp. Sta. Bul. 128.)

General notes on orchard treatment; insect and fungus pests. Bridge-grafting to save girdled trees.

- 1906 Walker, E. Suggestions upon the care of apple

orchards. 139-210 p. illus. (Arkansas Agr.

Exp. Sta. Bul. 91).

Rejuvenation of an orchard of 27 acres of old bearing trees. Work begun in 1904; in 1905 there were 534 barrels of No. 1 apples, value

\$2077.57 and \$240.00 worth of No. 2. Expense, \$883.30.

Many good points on orchard renovation.

1907. Munson, W. M. Orchard Notes, 1906. 49-64 p.

illus. (Maine Agr. Exp. Sta. Bul. 139.)

Orchard experiments in Kenebec Co., cultivation, mulching, fertilizing, orchard renovation, top grafting and the use of cover crops.

- 1907 Ballou, F. H. Renewal of old orchards. 87-110

p. illus. (Ohio Agr. Exp. Sta. Bul. 180.)

Specific results of renewal of orchard trees. Forty years old neglected apple trees were severely headed in, trimmed and sprayed, with a result of about 30 bushels of apples to the tree the first year. Also experiments in renovation of peach orchards.

- 1908 Lewis, C. I., Bennett, C. L., and Vincent, C. C.

Orchard survey of Jackson County. 55 p.

illus. (Oregon Agr. Exp. Sta. Bul. 101.)

Notes on thorough orchard practice. Show what modern methods will do with even very old trees (20-50 years in some cases) that had been neglected. Excellent notes on preparation of fruit and marketing.

- 1908 Munson, W. M. Orchard Notes, 1907. 123-156 p.

diagr. (Maine Agr. Exp. Sta. Bul. 155.)

General discussion of orchard management. Under orchard renovation, p. 133, it is shown that old neglected orchards may be made very profitable.

- 1908 Parrott, P. J. Remedies for the San Jose scale

and directions for their use. 12 p. illus.

(New York (Geneva) Agr. Exp. Sta. Cir. 9.)

Thorough treatment of San Jose scale in old orchards. Brief notes on thinning out and pruning of old apple orchards.

- 1908 Parrott, E. J., Hodgkiss, H. E. and Schoene, W. S.
Control of scale in old apple orchards. 30 p.
illus. New York (Geneva) Agr. Exp. Sta. Bul.
296.
Gives results of experiments treating trees,
30 to 50 years of age, which were badly infested.
Best results with lime-sulphur or home made oil
emulsions. Scale controlled by first lowering
heads of the tall trees 10 ft. by pruning, and
thorough spraying. Cost per tree, 32 ¢.
- 1908 Sears, F. C. Renovating old orchards. 406-414,
illus. (In Mass. Bd. of Agr., Pub. Doc. No. 4.
Shows the kind of trees that can be profit-
ably renovated. General treatment, cultivation,
fertilization and cover-crops.
- 1909 Gossard, H. A. Apple spraying in 1908. 8 p.
illus. Ohio Agr. Exp. Sta. Cir. 95.
Records the wonderful results of thorough
spraying alone on a 12 acre orchard of trees
12-14 years old. Return for fruit \$7400.00
for the year.
- 1909 Stuart, V. Apple culture in Vermont. 61-100 p.
illus. Vermont Agr. Exp. Sta. Bul. 141.
General consideration of the factors neces-
sary for apple production, with a final chapter
on marketing the crops.
- 1909 Cummings, M. B. Apple orchard survey of Niagara
County, 279-320 p. illus. New York (Cornell)
Agr. Exp. Sta. Bul. 262.
Discusses conditions of old orchards and
factors of their productiveness.
- 1909 Hedrick, U. P. How Sod affected an apple orchard.
77-132 p. illus. diagr. New York (Geneva) Agr.

Exp. Sta. Bul. 314.

A comparison of tillage and sod mulch in old apple orchard. Results very favorable to tillage.

- 1909 Waugh, F. A. Renovation of old orchards. Chap. XVIII, 188-191 p. (In The American Apple Orchard -- New York: Orange Judd Company, 1909.)
1. The physical condition of the soil must be improved.
 2. Plant food provided.
 3. Trees pruned.
 4. Trunks scraped.
 5. Sprays
- 1909 Whipple, O. B. Pruning mature fruit trees. 20 p. illus. Colorado Agr. Exp. Sta. Bul. 139.
- Discusses the treatment of wounds, thinning apples, etc. Physiology of pruning: during growing season increases fruitfulness; during dormant season, increased growth of wood.
- 1909 Hartman, S. B. and Eustace, H. S. Can the general farmer afford to grow apples? and suggestions on improving and spraying apple orchards. 33-48 p. illus. Michigan Agr. Exp. Sta. Bul. 253.
- General directions for improving neglected apple orchards. Figures given of specific results.
- 1909 Woodbury, C. C. The Farmer's Orchard. 42 p. illus. Indiana (Purdue) Agr. Exp. Sta. Cir. 17.
- The latter part of this bulletin takes up the methods to be employed in the renovation of the neglected home orchard.
- 1910 Jarvis, C. D. Apple growing in New England.
- I. The apple industry.
 - II. Renovation of old apple orchards. 59-89 p. illus. Coun. Storrs

Agr. Exp. Sta. Bul. 61.

I. History of commercial apple-growing. Neglected orchards a hindrance to the apple industry. Low grade fruit put on market. Careless and dishonest packing. Favorable soil, climate and market. Apple production of U. S. diminishing; export increasing. Apples profitable investment.

II. The neglected orchard the usual thing in New England. A consideration of conditions in old orchards. Method of procedure - pruning, thinning and shaping the trees. Caring for wounds. Treating the soil, by cultivation, cover crops, fertilization etc. Changing varieties, by cleft grafting. Spraying. Mr. Drew's work of renovation at Conyers Manor, Greenwich, Conn.

- 1910 Ballou, F. H. Apple culture in Ohio. 525-559.
illus. Ohio Agr. Exp. Sta. Bul. 217.

History of the apple industry in Ohio. There is a rapid awakening. Conditions favoring apple growing. Renewal of orchards, pruning, spraying, thinning, etc.

- 1910 Hitchings, E. F. Orchard renovation. 5-11 p.
illus. (In Better fruit for Maine. In Maine Bul. Dept. Agr. Vol. ix, No. 1.

More than ninety per cent of the orchards of the State are suffering for want of care. Begin renovation by removing dead wood and all cankers, sterilize with a solution of copper sulphate and paint all cuts. Open up tops, spray thoroughly with dormant lime-sulphur. Cultivate, fertilize, and in the case of poor trees, top work etc.

- 1910 Jarvis, C. D. Apple growing in New England.
III. Planting the apple orchard. 91-139 p.
illus. Conn. Storrs Agr. Exp. Sta. Bul. 62.

Notes of value to one getting an orchard to renovate. Selecting the land; varieties; care of the orchard, etc.

- 1911 Abraham, O. R. Renewing old Orchards. The Fruit Grower. St. Joseph, Mo., Dec., 1911, p. 6. Indiana.

Describes the renewing of some old Milam apple trees (75 years old), which had not produced a crop for years and were badly decayed. They were thoroughly pruned and sprayed with lime-sulphur and arsenate of lead. A good crop the first year.

- 1911 Drew, G. A. Reclaiming old apple orchards. 44-52 p. (In 56 Ann. Proc. West New York Hort. Soc.

Pruning. Low heading for easy spraying, picking and less danger from winds. Good results in 2 years after topping.

Surgery. Put in cement, bolts and cable-wire. Use tar in cavities and on all cuts.

Spraying. Oils for scale on rough trees. Lime-sulphur to clean up old trees in spring.

Cultivation. Use disc or cutaway harrow and follow with spring tooth. Seed down to clover and let trees lay in sod until they show that it should be broken up again. Better color on sod. Cut and leave clover on ground.

Fertilization. Use chemicals. Sulphate and nitrate of potash, ground-bone, wood-ashes, nitrate of soda and basic slag for the phosphoric acid and lime. Muriate of potash removes lime from soil. 100 pounds nitrate of soda, 200 pounds sulphate of potash, 500 pounds basic slag. Later less nitrogen, but a dressing of basic slag, 300 or 400 pounds each year with 150 pounds of sulphate of potash.

Thinning. Costs 50 ¢ per tree, but pays well.

Cost of Renovation. One to five dollars per tree.

Results of Renovation. 30 year old Baldwin and Greenings.

100 barrels of poor fruit before from 200 trees.

800 barrels of choice fruit after from 200 trees.

Another 25 year old orchard. Baldwin. 9 barrels per tree three years after treating -

all choice fruit.

Value of Apple trees. Rhode Island State Bd. of Agr. estimated value of Baldwin and Greening apple trees, 40 years old, \$150.00 each, 60 years old, \$250.00 each.

- 1911 F_____, H. W. Making new trees out of old ones in Pennsylvania. The Fruit Grower. (Missouri) Jan., 1911, 48-49 p.
- Describes work of Div. of Zool. of the Penn. Dept. of Agr. in redeeming old orchards. One or more orchards taken in each county.
- 1911 Hedrick, U. P. Renovation of Wornout Orchards. New York Dept. Agr. Cir. 43. (Also published in Bul. 28.)
- Brief discussion of orchard conditions in the State. Factors in renovation. (1) Removing surplus trees. (2) Prune thoroughly. (3) Soil treatment-drain and treat sour spots. (4) Fertilizers. (5) Scraping. (6) Spraying. (7) Cultivation. (8) Cover crops.
- 1911 Jarvis, C. D. Apple growing in New England. IV. Orchard management. March, 1911. 211-263 p. illus. 23 cm. Gonn. Storrs Agr. Exp. Sta. Bul. 66.
- Notes of value to one getting an orchard to renovate. Cultural systems; soil management; pruning; spraying; thinning apples; etc.
- 1911 Moore, J. G. The management of a bearing orchard. 34 p. illus. Wisconsin Agr. Exp. Sta. Bul. 207.
- General consideration of orchard practice with excellent notes on the pruning etc. of neglected orchards.
- 1911 Sage, H. High pressure orcharding in New England. Garden Magazine, V. 23, 270-273 p., illus.

100 acre orchard in Vermont, with a \$20,000.00 crop in 1909.

- 1911 Watt, G. A. Reclaiming an old apple orchard in Ohio. The Fruit Grower. (Missouri) Jan., 1911, 49-50p.

720 Trees, 40 years old, in very bad shape were sprayed, pruned, repaired and made to bear a profitable crop.

- 1912 Ballou, F. H. Improvement of farm orchards.

The Ohio Farmer, Mar.2, 1912, p. 1.

Compares infested trees with scabby stock; the latter would never be tolerated on the farm. Varieties for Ohio - Wealthy, Grimes, Spy, Jonathan, Sutton, Stayman, etc. Trouble in old orchards due to pruning up and consequent decay.

The general principles of renovation are considered - removing tall branches, scraping, spreading manure generously, out under the branches, straw mulch to conserve moisture or flow, application of complete fertilizers as follows: 100 lbs. nitrate of soda, 100 lbs. acid phosphate or ground bone and 50 lbs. muriate of potash, per acre, good results in due season. Apply at beginning of growing season. Thorough spraying. 1st, just as the buds are swelling, 2d, just after the blossoms fall, 3rd, same two weeks later, 4th, the latter part of July spray with lime sulphur or Bordeaux with arsenate.

- 1912 Cole, E. F. Open head pruning. The Fruit Grower (Missouri) March, 1912, 32-33 p.

Tall trees should be lowered by removing the central or vertical branches at the crotch or as near the crotch as possible. As much as possible the cutting should be done on the inside of the tree, so as to push out the side branches to broaden the top.

The objections - non-healing, sunscald, etc. are proved to be false theories by practice, when the trees were well cared for, even though the cuts are left untreated.

Objects of low-heading: (1) To bring the trees down to where they can be handled economically. (2) Gives greater bearing surface. By removing the top the strength is thrown to the side branches. Also, the center of the tree being light will produce fruit spurs on the larger wood.

By this method five boxes of choice fruit produced within reach, in place of a single box produced near the tips of the upright limbs.

Contrary to common opinion, heavy pruning out of the upright growth during dormant period, forces a heavy fruit crop.

- 1912 Fraser, S. Grower's experience with orchard fertilizers. N. Y. Tribune Farmer Jan. 18, p. 4

Six and one half acres neglected, in sod, 1906 - 33 x 33 ft. Land plowed. Half of the trees removed diagonally in 1907. Land manured twice 1908, nitrate of soda applied. Encouraged growth. In 1910 basic slag 800 lbs. per acre, gave results in growth, color and finish of fruit. 1000 lbs. per acre in 1912 to all trees.

Gross results for orchard. 1906 - \$900.00; 1907 - \$630.00; 1908 - \$1320.00; 1909 - \$1340.00; 1910 - \$1280.00; 1911 - 130 bbls. per acre not sold. 5 year average from time of renovation = \$168.30 per acre gross.

One ton basic slag has about 360 lbs. phosphoric acid and 900 lbs. lime, both of value to the soil.

1912. Lattin, F. H. My experience in reclaiming old apple orchards. 149-165 p. (In New York St. fruit growers assn. Proceedings, V. XI.) (Same in Fruit Grower (Missouri) Feb., 1912.)

This article describes most excellent results obtained by Dr. Lattin by the renovation of old orchards in Orleans and Oswego Counties, N. Y.

